

CLAIMS

1. A method of generating a modulated navigation signal (7) which is intended to be used to position a downlink receiver (6), comprising multiple pseudorandom navigation codes of chip rhythms greater than 0.5 MHz, modulated onto a carrier of frequency f_p greater than 500 MHz, wherein four pseudorandom navigation codes C_1 , C_2 , C_1' , C_2' are modulated onto the carrier according to an 8-PSK modulation of constant amplitude with a modulation frequency f_M such that:

$$8f_c \leq f_M$$

where $f_c = \text{Max}(f_{ci})$, and f_{ci} designates the chip rhythms f_{c1} , f_{c1}' , f_{c2} , f_{c2}' of the navigation codes C_1 , C_2 , C_1' , C_2' , each f_{ci} value being such that $f_M = N_i.f_{ci}$, N_i being an integer greater than or equal to 8, two navigation codes C_1 , C_1' being quadrature modulated at frequency $f_1 = f_p - f_M/8$, and two other navigation codes C_2 , C_2' being quadrature modulated at frequency $f_2 = f_p + f_M/8$, and the modulated navigation signal presenting a constant envelope.

2. A method as claimed in claim 1, wherein f_M is chosen to be ≤ 400 MHz.

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3. A method as claimed in claim 1, for generating a modulated navigation signal (7) on board a space satellite, wherein f_M is chosen to be ≤ 200 MHz.

30 4. A method as claimed in one of claims 1 to 3, wherein 8-PSK modulation of symmetrical constant amplitude in the Fresnel plan is used.

5. A method as claimed in one of claims 1 to 3, wherein 8-PSK modulation of asymmetrical constant amplitude in the Fresnel plan is used.

6. A method as claimed in one of claims 1 to 5, wherein 8-PSK modulation of phase states equal to $k \cdot \pi/4$, where k is an integer between 1 and 8, is used.

7. A method as claimed in one of claims 1 to 6, wherein the four codes are modulated according to a truth table which is chosen from the group of truth tables formed from:

TABLE 1

C1(t)	-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1	1	1	1	1
C2(t)	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	1	1	1
C1'(t)	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1
C2'(t)	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1
t modulo 8TM																
[0, TM[	P5	P4	P4	P3	P6	P7	P5	P2	P6	P1	P3	P2	P7	P8	P8	P1
[TM, 2TM[	P5	P8	P4	P3	P6	P7	P5	P6	P2	P1	P3	P2	P7	P8	P4	P1
[2TM, 3TM[	P1	P8	P4	P7	P6	P7	P5	P6	P2	P1	P3	P2	P3	P8	P4	P5
[3TM, 4TM[	P1	P8	P8	P7	P2	P7	P5	P6	P2	P1	P3	P6	P3	P4	P4	P5
[4TM, 5TM[	P1	P8	P8	P7	P2	P3	P1	P6	P2	P5	P7	P6	P3	P4	P4	P5
[5TM, 6TM[	P1	P4	P8	P7	P2	P3	P1	P2	P6	P5	P7	P6	P3	P4	P8	P5
[6TM, 7TM[P5	P4	P8	P3	P2	P3	P1	P2	P6	P5	P7	P6	P7	P4	P8	P1
[7TM, 8TM[P5	P4	P4	P3	P6	P3	P1	P2	P6	P5	P7	P2	P7	P8	P8	P1

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TABLE 2

C1(t)	-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1	1	1	1	1
C2(t)	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	1	1	1

$C1'(t)$	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1
$C2'(t)$	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1
t modulo $8T_M$																
$[0, T_M[$	P1	P8	P4	P7	P6	P7	P5	P6	P2	P1	P3	P2	P3	P8	P4	P5
$[T_M, 2T_M[$	P1	P8	P8	P7	P2	P7	P5	P6	P2	P1	P3	P6	P3	P4	P4	P5
$[2T_M, 3T_M[$	P1	P8	P8	P7	P2	P3	P1	P6	P2	P5	P7	P6	P3	P4	P4	P5
$[3T_M, 4T_M[$	P1	P4	P8	P7	P2	P3	P1	P2	P6	P5	P7	P6	P3	P4	P8	P5
$[4T_M, 5T_M[$	P5	P4	P8	P3	P2	P3	P1	P2	P6	P5	P7	P6	P7	P4	P8	P1
$[5T_M, 6T_M[$	P5	P4	P4	P3	P6	P3	P1	P2	P6	P5	P7	P2	P7	P8	P8	P1
$[6T_M, 7T_M[$	P5	P4	P4	P3	P6	P7	P5	P2	P6	P1	P3	P2	P7	P8	P8	P1
$[7T_M, 8T_M[$	P5	P8	P4	P3	P6	P7	P5	P6	P2	P1	P3	P2	P7	P8	P4	P1

where P1, P2, P3, P4, P5, P6, P7, P8 are the various contacts and the 8-PSK constellation, and $T_M = 1/f_M$, and other truth tables derived from these truth tables TABLE 1 and TABLE 2 by
5 phase rotation by $n \cdot \pi/4$, $n \in \{1, 2, 3, 4, 5, 6, 7\}$ and/or reversal of the direction of the path of the constellation.

8. A method as claimed in one of claims 1 to 7, wherein f_p is between 1000 MHz and 1700 MHz.

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9. A method as claimed in one of claims 1 to 8, wherein f_c is of the order of 10 MHz.

10. A method as claimed in one of claims 1 to 9, wherein f_M
15 is of the order of 120 MHz.

11. A method as claimed in one of claims 1 to 10, wherein in
at least one pair of codes $C1, C1'$; $C2, C2'$ which are
quadrature modulated onto the same frequency, one $C1'$; $C2'$
20 incorporates digital data which is modulated according to a
frequency less than $f_c/1000$.

12. A device for generating a modulated navigation signal (7) which is intended to be used to position a downlink receiver (6), comprising multiple pseudorandom navigation
 5 codes of chip rhythms greater than 1 MHz, modulated onto a carrier of frequency f_p greater than 500 MHz, this device comprising:

- a circuit (11) to generate pseudorandom navigation
 10 codes,
- a phase-shifting modulator circuit (13) which supplies the modulated navigation signal (7) on the carrier,
- 15 - an emitter circuit (15), comprising at least one power amplification stage, and suitable for emitting a radio frequency signal corresponding to the modulated navigation signal,

20 wherein the modulator circuit (13) is suitable for modulating, on the carrier, four pseudorandom navigation codes C_1 , C_2 , C_1' , C_2' of which the frequencies are an integer multiple of one of them f_c , according to an 8-PSK modulation of constant amplitude with a modulation frequency
 25 f_M such that:

$$8f_c \leq f_M$$

where $f_c = \text{Max}(f_{ci})$, and f_{ci} designates the chip rhythms f_{c1} ,
 30 f_{c1}' , f_{c2} , f_{c2}' of the navigation codes C_1 , C_2 , C_1' , C_2' , each f_{ci} value being such that $f_M = N_i \cdot f_{ci}$, N_i being an integer greater than or equal to 8, two navigation codes C_1 , C_1' being quadrature modulated at frequency $f_1 = f_p - f_M/8$, and

two other navigation codes C_2 , C_2' being quadrature modulated at frequency $f_2 = f_p + f_M/8$, and the modulated navigation signal presenting a constant envelope.

5 13. A device as claimed in claim 12, wherein the modulator circuit (13) is suitable for implementing an 8-PSK modulation with a modulation frequency $f_M \leq 400$ MHz.

14. A device as claimed in claim 12, wherein the modulator
10 circuit (13) is suitable for implementing an 8-PSK modulation with a modulation frequency $f_M \leq 200$ MHz.

15. A device as claimed in one of claims 12 to 14, wherein the modulator circuit (13) is suitable for implementing 8-PSK
15 modulation of symmetrical constant amplitude in the Fresnel plan.

16. A device as claimed in one of claims 12 to 14, wherein the modulator circuit (13) is suitable for implementing 8-PSK
20 modulation of asymmetrical constant amplitude in the Fresnel plan.

17. A device as claimed in one of claims 12 to 16, wherein the modulator circuit (13) is suitable for implementing 8-PSK
25 modulation of phase states equal to $k \cdot \pi/4$, where k is an integer between 1 and 8.

18. A device as claimed in one of claims 12 to 17, wherein the modulator circuit (13) is suitable for modulating the
30 four codes according to a truth table which is chosen from the group of truth tables formed from:

TABLE 1

$C1(t)$	-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1	1	1	1	1
$C2(t)$	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	1	1	1
$C1'(t)$	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1
$C2'(t)$	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1
t modulo 8TM																
$[0, TM[$	P5	P4	P4	P3	P6	P7	P5	P2	P6	P1	P3	P2	P7	P8	P8	P1
$[TM, 2TM[$	P5	P8	P4	P3	P6	P7	P5	P6	P2	P1	P3	P2	P7	P8	P4	P1
$[2TM, 3TM[$	P1	P8	P4	P7	P6	P7	P5	P6	P2	P1	P3	P2	P3	P8	P4	P5
$[3TM, 4TM[$	P1	P8	P8	P7	P2	P7	P5	P6	P2	P1	P3	P6	P3	P4	P4	P5
$[4TM, 5TM[$	P1	P8	P8	P7	P2	P3	P1	P6	P2	P5	P7	P6	P3	P4	P4	P5
$[5TM, 6TM[$	P1	P4	P8	P7	P2	P3	P1	P2	P6	P5	P7	P6	P3	P4	P8	P5
$[6TM, 7TM[$	P5	P4	P8	P3	P2	P3	P1	P2	P6	P5	P7	P6	P7	P4	P8	P1
$[7TM, 8TM[$	P5	P4	P4	P3	P6	P3	P1	P2	P6	P5	P7	P2	P7	P8	P8	P1

TABLE 2

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$C1(t)$	-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1	1	1	1	1
$C2(t)$	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	1	1	1
$C1'(t)$	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1
$C2'(t)$	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1
t modulo 8TM																
$[0, TM[$	P1	P8	P4	P7	P6	P7	P5	P6	P2	P1	P3	P2	P3	P8	P4	P5
$[TM, 2TM[$	P1	P8	P8	P7	P2	P7	P5	P6	P2	P1	P3	P6	P3	P4	P4	P5
$[2TM, 3TM[$	P1	P8	P8	P7	P2	P3	P1	P6	P2	P5	P7	P6	P3	P4	P4	P5
$[3TM, 4TM[$	P1	P4	P8	P7	P2	P3	P1	P2	P6	P5	P7	P6	P3	P4	P8	P5
$[4TM, 5TM[$	P5	P4	P8	P3	P2	P3	P1	P2	P6	P5	P7	P6	P7	P4	P8	P1
$[5TM, 6TM[$	P5	P4	P4	P3	P6	P3	P1	P2	P6	P5	P7	P2	P7	P8	P8	P1
$[6TM, 7TM[$	P5	P4	P4	P3	P6	P7	P5	P2	P6	P1	P3	P2	P7	P8	P8	P1
$[7TM, 8TM[$	P5	P8	P4	P3	P6	P7	P5	P6	P2	P1	P3	P2	P7	P8	P4	P1

where P1, P2, P3, P4, P5, P6, P7, P8 are the various contacts and the 8-PSK constellation, and $T_M = 1/f_M$, and other truth tables derived from these truth tables TABLE 1 and TABLE 2 by phase rotation by $n \cdot \pi/4$, $n \in \{1, 2, 3, 4, 5, 6, 7\}$ and/or reversal
5 of the direction of the path of the constellation.

19. A device as claimed in one of claims 12 to 17, wherein f_p is between 1000 MHz and 1700 MHz.

10 20. A device as claimed in one of claims 12 to 19, wherein f_c is of the order of 10 MHz.

21. A device as claimed in one of claims 12 to 20, wherein f_M is of the order of 120 MHz.

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22. A device as claimed in one of claims 12 to 21, which is adapted so that in at least one pair of codes which are quadrature modulated onto the same frequency, one C1', C2' incorporates digital data which is modulated according to a
20 frequency less than $f_c/1000$.